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(54) MANUFACTURING METHOD OF ELECTROMAGNETIC WAVE SHIELD MATERIAL

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a method for manufacturing an electromagnetic wave shield material of carbon fiber excellent in workability without a large scale production facility.

SOLUTION: A cloth material comprising a silk fiber (fibroin fiber) refined with enzyme is baked in a radiation heat within a baking furnace which contains no oxygen. Thus, the silk fiber is carbonized and the cloth material provides an electromagnetic wave shielding characteristics.

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CLAIMS

[Claim(s)]

[Claim 1] The manufacture approach of the electromagnetic shielding material which puts the cloth material creation process which creates the cloth material which consists of the silk fibre by which refinement processing was carried out with the enzyme, and said cloth material into a firing furnace, changes the interior of this firing furnace into an anoxia condition, and is characterized by to have the baking process which calcinates this cloth material with radiant heat, and the recall process which obtains a product by cooling the cloth material calcinated at said baking process.

[Claim 2] Said baking process is the manufacture approach of the electromagnetic shielding material according to claim 1 characterized by including the first baking process which calcinates cloth material at the first temperature, the cooling process which cools the cloth material calcinated at said first baking process, and the second baking process which calcinates cloth material at the second temperature higher than said first temperature.

[Claim 3] Said cloth material creation process is the manufacture approach of the electromagnetic shielding material according to claim 1 or 2 characterized by to include the process which obtains the silk nonwoven fabric which a grain direction is changed and carries out the laminating of the process which carries out refinement processing of the silk fibre raw materials, such as a cocoon for egg production, with an enzyme, the process which carries out hackling opening of the silk fibre raw material by which refinement processing was carried out, and is used as a sheet-like object, and said two or more sheet-like objects, carries out needling and changes as said cloth material.

[Claim 4] The manufacture approach of the electromagnetic shielding material according to claim 1 to 3 characterized by including further fluorine down stream processing which lets the electromagnetic shielding material obtained at said recall process pass in a fluorine gas ambient atmosphere.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]**[0001]**

[Field of the Invention] This invention relates to the manufacture approach of an electromagnetic shielding material.

[0002]

[Description of the Prior Art] The thing of a publication is known by JP,61-35599,A as an electromagnetic shielding material of the shape of blanket-like or a sheet. this electromagnetic shielding material change from the conductive liner sheet which carried out thermal spraying of the metal to the front face of a carbon fiber or activated carbon fiber -- it be, and it can also form a very thin thing easily, moreover various configurations can be process it not only have the electromagnetic wave shielding effect of carbon and each metal, but, and it be suppose that the manufacture approach be also easy and it be suitable for mass production method (the claim (1) of this official report, the 2nd page left lower column of the 1-10th line). The carbon cloth (eyes 90 g/m²) which carbonizes phenol system novolak fiber cloth (700-micrometer thickness) under an inert gas ambient atmosphere, and changes as an example of the carbon fiber used for this electromagnetic shielding material is mentioned (the 2nd page left lower column of the 12-14th line of this official report).

[0003]

[Problem(s) to be Solved by the Invention] By the above-mentioned electromagnetic shielding material, in order to compensate lack of the electromagnetic wave shielding effect by carbon cloth, it is thought that the metal layer is formed in the front face of the cloth. However, if the electromagnetic wave shielding effect of the carbon cloth itself can be made high enough, since it will become unnecessary to form a metal layer further, it is advantageous when performing simplification of a production facility, and reduction of a production cost. The place which accomplishes this invention in order to solve such a technical problem, and is made into the purpose is to offer the approach of manufacturing the electromagnetic shielding material excellent in workability made from a carbon fiber, without using a large-scale production facility.

[0004]

[Means for Solving the Problem] The manufacture approach of the electromagnetic shielding material concerning this invention which accomplished in order to solve the above-mentioned technical problem puts the cloth material creation process which creates the cloth material which consists of the silk fibre by which refinement processing was carried out with the enzyme, and said cloth material into a firing furnace, and changes the interior of this firing furnace into an anoxia condition, and it carries out having the baking process which calcinates this cloth material with radiant heat, and the recall process which obtain a product by cooling the cloth material calcinated at said baking process as the description.

[0005]

[Embodiment of the Invention] By the approach concerning this invention, the cloth material which consists of a silk fibre (fibroin fiber) is calcinated with radiant heat in the firing furnace of an anoxia condition. A silk fibre carbonizes by this and cloth material gains electromagnetic wave shielding. Baking conditions (the presentation of the ambient atmosphere in a firing furnace, a pressure, burning temperature, firing time, etc.) are determined that the fibroin fiber which is the subject of a silk fibre will come to present a desired carbonization condition by baking. Textile fabrics or a nonwoven fabric is

sufficient as cloth material. As a firing furnace, an electric furnace can use suitably.

[0006] The silk thread which is the raw material of a silk fibre has the structure with which SESHIRIN covered the front face of fibroin fiber in the shape of film. When it remains without removing SESHIRIN completely in creation of cloth material, the SESHIRIN gasifies in a baking process, it adheres to the bleeder of the suction system with which the firing furnace was equipped etc., and blinding is started or there is a possibility of generating the problem of adhering to the internal surface of a firing furnace. In consideration of such a problem, the cloth material which consists of the silk fibre which performed refinement processing with the enzyme is used by this invention. SESHIRIN which has covered fibroin fiber with refinement processing of the silk fibre by the enzyme is removed completely.

[0007] Moreover, the above-mentioned refinement processing is effective also in removal of the impurity adhering to the silk fibre which constitutes cloth material.

[0008] It is good for creation of the cloth material which consists of a silk fibre to use the technique of a publication for example, for the patent No. 2690070 official report. The approach of creating a silk nonwoven fabric using the so-called, cheaply available triangular floss silk is indicated by this official report. By this approach, the silk fibre which makes fibroin fiber a subject is obtained by carrying out refinement processing of the triangular floss silk cut out by the square of 3.5cm - 5.0cm with an enzyme first. The silk fibre after refinement processing is presenting tabular [hard]. The sheet-like object of a silk fibre is obtained by carrying out hackling opening of this tabular silk fibre with a woolen card. Removing the foreign matter which is adhering or mixing the silk fibre in the triangular floss silk which is a natural product besides fabricating in the shape of a sheet also makes this hackling filamentation processing the purpose. In this way, the grain direction is equal to the one direction, and although the tensile strength in the longitudinal direction of fiber is size, the tensile strength in the direction which intersects perpendicularly with it is small [as for the sheet-like object of the obtained silk fibre]. Then, the nonwoven fabric of one sheet with uniform reinforcement is obtained in each direction by changing the grain direction, carrying out the laminating of two or more sheet-like objects, and making fiber become entangled by needling. The nonwoven fabric of various eyes can be obtained by changing the number of sheets of the sheet-like object which carries out a laminating. In this way, the obtained nonwoven fabric is used as cloth material of this invention. In this cloth material, the interface is formed between the adjoining sheet-like objects of two sheets, and this has heightened the electromagnetic wave shielding (reflection) effectiveness.

[0009] Moreover, if elevated-temperature baking of the cloth material is carried out in an owner oxygen ambient atmosphere, even if cloth material does not burn or it does not burn, the product obtained will become the shape of not a desired condition (solid-state) but powder, or tar. In consideration of this problem, by this invention, the inside of a firing furnace is changed into an anoxia condition, and cloth material is calcinated. An anoxia condition can be attained by removing the air in a firing furnace with a vacuum pump. Burning temperature and firing time are determined in consideration of the configuration of a firing furnace, the amount of the cloth material made applicable to baking, a configuration, a dimension, etc.

[0010] If cloth material is calcinated at an elevated temperature at a stretch in a baking process, the fiber which constitutes cloth material will be damaged violently. In consideration of this, said baking process includes the first baking process which calcinates cloth material at the first temperature, the cooling process which cools the cloth material calcinated at said first baking process, and the second baking process which calcinates cloth material at the second temperature higher than said first temperature in the desirable gestalt of this invention. The first temperature and second temperature set up as a standard the decomposition temperature and the melting temperature of amino acid which constitute a silk fibre. Thus, the product by which quality was stabilized more is obtained by calcinating cloth material in two steps.

[0011] Moreover, it is a fluorine gas ambient atmosphere (temperature of 100-150 degrees C.) about the electromagnetic shielding material obtained at said recall process in the desirable gestalt of this invention. Fluorine down stream processing which it lets pass in 120-130 degrees C preferably is prepared further. Thereby, the reinforcement of a product is raised. In addition, it is made to perform this fluorine down stream processing twice preferably.

[0012]

[Effect of the Invention] Since the manufacture approach of the electromagnetic shielding material concerning this invention does not fix conductive matter, such as a metal, to the front face of carbon cloth material or does not need the conductive matter or ingredients other than a carbon fiber unlike the approach of ***** which mixes a carbon fiber and other conductive fiber and weaves cloth material, simplification of a production facility can be attained. Moreover, since the electromagnetic shielding material obtained by the approach concerning this invention is a sheet-like product which consists of a carbon fiber, it is rich in flexibility and excellent in workability.

[0013]

[Example] The electromagnetic shielding material was manufactured in the following procedures.

[0014] (The first process) The silk nonwoven fabric (eyes 100 - 200 g/m²) was created from triangular floss silk by the approach of a publication in the patent No. 2690070 official report.

(The second process) The laminating of the silk nonwoven fabric obtained at the first process was carried out in 80% of the amount of volume into the electric furnace by Chugai Ro Co., Ltd., and baking by radiant heat was performed for 1 hour on the baking conditions of atmospheric-pressure 0.03Torr in a furnace, and the temperature of 350-450 degrees C.

(The third process) After the second process, by spraying an oil on the wall of a furnace, whenever [furnace temperature] was lowered and the silk nonwoven fabric was fully cooled.

(The fourth process) The second baking by radiant heat was performed after the third process for 30 minutes per hour on the baking conditions of atmospheric-pressure 0.03Torr and the temperature of 1000-1200 degrees C.

(The fifth process) The silk nonwoven fabric which passed through the fourth process was cooled by natural heat dissipation, and the product of an electromagnetic shielding material was obtained.

[0015] The energization nature test and the test of an electromagnetic wave shielding effect were performed using the product obtained as mentioned above. The electromagnetic wave made applicable to shielding was aimed at the electromagnetic wave generated mainly from electrical machinery and apparatus, such as the electromagnetic wave generated in everyday life, for example, television, radio, a cellular phone, remote control, and a computer. The energization nature and the electromagnetic wave shielding effect of the above-mentioned product have checked that it was the thing of extent utilizable enough as a result of these tests.

[Translation done.]